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Original Article

An Analysis of Emergency Treatment-seeking Characteristics in Elderly Patients in Taiwan in 2010☆

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SUMMARY

Background: The aim of this study was to understand the differences in demographic data and emergency department (ED) diagnosis between different age groups of patients.
Materials and Methods: This study is based on data from the 2010 National Health Insurance Research Database published by the Taiwan National Health Research Institutes. We used descriptive statistics and bivariate statistical analysis to obtain the number of emergency visits in 2010. The main variables for analysis included demographic data and treatment-seeking characteristics, such as age, sex, marital status, International Classification of Diseases diagnostic code (International Classification of Diseases, 9th Revision, Clinical Modification), and medical institutions.
Results: Data from the cohort sample of the 200,000 random samples taken from the health insurance beneficiary files of the National Health Insurance Research Database found a total 277,384 ED visits during 2010 after exclusion of unusual frequent ED users (hemophilia B or schizophrenia), 58,014(20.91%) of which were attributed to elderly patients. Female patients were predominantly in the elderly ED visits.
Conclusion: The average cost of emergency medical expenses, number of ED visits, and subsequent hospitalization are significantly higher in elderly ED patients.

1. Introduction

In 1993, people over the age of 65 years accounted for 7% of the total population of Taiwan, and therefore, in accordance with the World Health Organization definition, Taiwan officially became an "aging society". At the end of 2008, those older than 65 years totaled 2,390,000, which accounted for more than 10% of Taiwan's total population. By 2012, this number had reached 2,600,000, or 11.15% of the total population, of whom 280,000 or 1.2% were older than 85 years.[1] With this progressive increase in the elderly population, Taiwan is currently facing the impact of an aging population, which could lead to problems related to social, health, and care needs that would require attention from the relevant authorities. Since the 1970s, the major causes of death in Taiwan have been associated with chronic disease, and of all age groups, the elderly rely most heavily on healthcare. Emergency departments (EDs) are medical treatment facilities that deal with emergencies, critical diseases, and accidents, and provide high-performance services 24 hours a day. It can be expected that with the increasing elderly population, there will also be increased utilization of emergency medical services (EMSs).[2]

Emergency services are the most costly of all medical services, and they are often in short supply. With the advances in medical technology and implementation of the National Health Insurance (NHI) scheme, the volume of hospital emergency services has been growing year by year. Annual records of hospital service volumes kept by the Department of Health-Executive Yuan show that from 1997 to 2011, the volume of EMSs rose from 5,257,705 to 7,473,627 visits each year, indicating a sustained upward trend in use by the public. From 2001 to 2011, the average daily volume of various medical services per hospital has seen an increase, and the number of emergency visits alone grew by 51.5%.[3] When the volume of EMSs continues to increase, the resulting "excessive cost of

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emergency health care", "overcrowding in emergency rooms", and "inability to provide continuity of emergency care" have a significant negative effect on the quality of healthcare.[4] Due to the degeneration of physical functions accompanied by chronic conditions and long-term medication use, the elderly have unique and complex clinical characteristics, and they therefore form a group of high users of emergency healthcare. It is therefore very important to find a way within the EMS system to provide adequate and measured services to this special group of elderly people. Regular evaluation of EMS utilization by the elderly in Taiwan would be helpful in assessing overall emergency healthcare resources and the continued demand of elderly patients for emergency and critical care. The use of long-term national data to obtain information on a regular basis on the utilization of EMSs by the elderly is helpful for the primary physician.

Because of cross-institutional data collection difficulties, most research on emergency medical treatment of elderly patients has involved detailed analysis of just a single medical institution, or a few institutions at most. After the introduction of NHI, a NHI research database was established, providing complete records of people seeking medical treatment. This database has been used in research for statistical analysis. Although the types of analyzed data may differ, they can still be used to depict the utilization of emergency medical resources in Taiwan and thus provide a reference on the appropriate allocation of emergency and critical care resources to relevant health authorities. The main objective of this study was to analyze ED utilization by people older than 65 years in 2010. We included patient characteristics, common disease diagnoses in the ED, and medical institution characteristics to understand differences in emergency care seeking behavior in the elderly (≥65 years) and this group's mode of seeking emergency treatment in 2010.

2. Materials and methods

2.1. Methods of measurement and data collection

This study is based on data from the 2010 NHI research database published by the Taiwan National Health Research Institutes. The NHI program was implemented in Taiwan in 1995 and provides compulsory universal health insurance. It enrolls about 99% of the Taiwanese population and contracts with 97% of all the country's medical providers.[5,6] The database contains comprehensive information on all insured individuals, including sex, date of birth, residential or work area, dates of clinical visits, diagnoses identified by International Classification of Diseases (9th revision) Clinical Modification (ICD-9-CM) diagnostic codes, details of prescribed medications and received procedures, expenditure amounts, and outcome at hospital discharge.[7]

2.2. Study population

This study is based on 200,000 random samples from the 2010 NHI research database published by the Taiwan National Health Research Institutes. This study group did not differ statistically from the larger cohort in age, sex, or healthcare costs, according to the Taiwan National Health Research Institute. The cause of disease was classified in accordance with the diagnostic codes of the ICD (ICD-9), and after distillation of the data, a statistical analysis of patients' emergency care seeking behavior and related factors was performed. After studying the basic information, we found that most patients who frequently sought emergency services (more than 20 times) in the year 2010 were cases with hemophilia B or schizophrenia. As the characteristics of this group of patients were different than those of other ED patients, we excluded this group from further analysis.

2.3. Statistical analysis

We used the SAS 9.2 statistical analysis software (SAS Institute Inc., Cary, NC, USA) for our analysis. After distillation of the data, we studied the distribution of the sample size (n), percentage (%), mean (M), and standard deviation (SD), and described the characteristics of the study sample as well as the principal diagnosis at each ED visit. Chi-square test, Student t test, and p values were used to compare the differences among nonelderly and elderly patients. We then used bivariate statistics for analysis of the effects of basic data from patients who are 65 years or older on their emergency care seeking behavior by sex and related factors. The main variables for analysis included patient data and treatment-seeking characteristics, such as age, sex, marital status, ICD diagnostic code (ICD-9-CM), and medical institution.

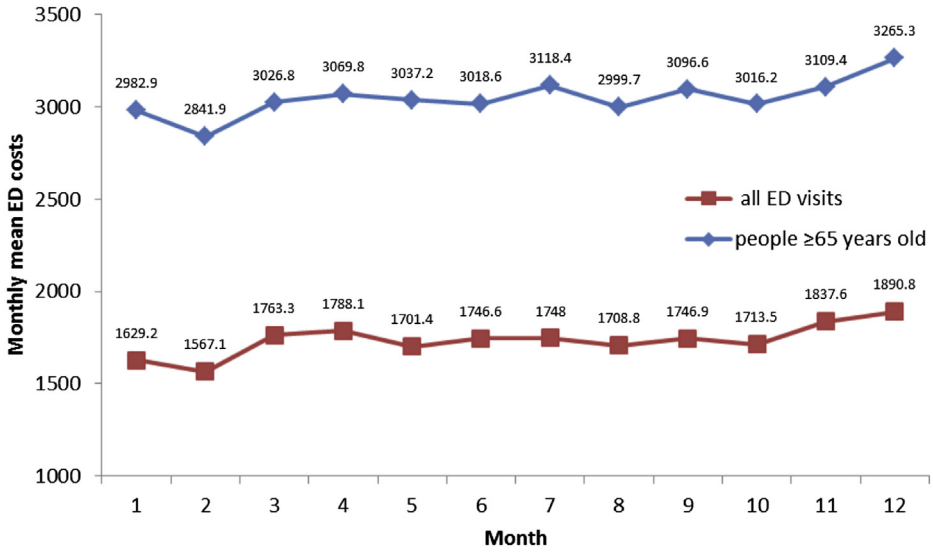

Figure 1. Distribution of emergency department (ED) visits by all ED visits versus people ≥65 years old from January to December 2010.

The study was approved by the Mackay Memorial Hospital Institutional Review Board on November 3, 2012 and remained valid until November 2, 2013(IRB Number: 12MMHIS136).

3. Results

In the current study cohort, the total number of ED visits was 277,384, of which 58,014 or 20.91% were made by patients 65 years and older from January to December in 2010 (Figure 1). On average, each individual made 1.6 emergency visits per year, resulting in monthly mean costs of NT$1734.60 per patient, whereas ED costs for patients 65 and older averaged NT$3047.70 per patient per month (Tables 1 and 2).

Table 3 shows basic information on emergency medical groups that contain nonelderly (≤64 years old) and elderly (≥65 year old) comparisons in 2010, and indicates a higher proportion of women in the elderly population. Emergency medical average ED expenses, number of hospital visits, out-of-hospital cardiac arrest (OHCA) cases, and after emergency hospitalization were significantly higher in the elderly population than in the nonelderly population.

Table 4 shows the ICD-9 diagnostic coding results during ED visits, indicating that the diagnoses were mostly involved symptoms, signs, and ill-defined disorders (ICD-9-CM 780–799), which accounting for 28.6% of cases, followed by injury and poisoning (ICD-9-CM 800–999) and diseases of the circulatory system (ICD-9-CM 390–459) (Figure 2). In the current study cohort, elderly patients had a higher rate of circulatory system disorders, yet had lower respiratory or digestive disease in the ED.

An analysis of elderly patient characteristics after classification can be found in Table 5. The results showed that sex, type of hospital visits, emergency medical expenses, annual emergency visits, OHCA cases, and emergency treatment results are significantly different. A higher proportion of males were found in the old elderly groups (≥5 years old). Old elderly population emergency medical expenses (ED cost) were significantly higher. The emergency medical average ED expenses for the old elderly population

Table 1
Distribution of all emergency department (ED) visits from January to December 2010.

Month	1	2	3	4	5	6	7	8	9	10	11	12	Total
n	24,144	22,703	22,622	21,919	24,223	22,713	24,448	25,005	24,004	22,953	20,708	21,942	277,384
Monthly mean ED costs	1629.2	1567.1	1763.3	1788.1	1701.4	1746.6	1748.0	1708.8	1746.9	1713.5	1837.6	1890.8	1734.6

Table 2
Distribution of emergency department (ED) visits by people ≥65 years old from January to December 2010.

Month	1	2	3	4	5	6	7	8	9	10	11	12	Total
n	4956	4766	4884	4724	4923	4746	5092	5142	4887	4824	4411	4659	58,014
Monthly mean ED costs	2982.9	2841.9	3026.8	3069.8	3037.2	3018.6	3118.4	2999.7	3096.6	3016.2	3109.4	3265.3	3047.7

Table 3
Patient characteristics after classification [2010 research, ≤64 years old vs. ≥65 years old (elderly)].

Variables	All patients *n* (%)	≤64 y old *n* (%)	≥65 y old *n* (%)	χ^2/t	*p*
Sex					
Female	86,717 (49.24)	71,737 (49.04)	14,980 (50.19)	12.98	<0.001
Male	89,409 (50.76)	74,540 (50.96)	14,869 (49.81)		
Mean age, mean ± SD (age)	38.3 ± 24.2	30.5 ± 18.2	76.5 ± 7.4	−716.37	<0.0001
Type of visited hospital					
Medical center	47,784 (27.13)	39,350 (26.90)	8434 (28.26)	48.39	<0.001
Regional hospital	87,929 (49.92)	73,216 (50.05)	14,713 (49.29)		
District hospital	38,722 (21.99)	32,225 (22.03)	6497 (21.77)		
Other	1691 (0.96)	1486 (1.02)	205 (0.69)		
ED costs, mean ± SD (NT$)	1628.8 ± 3007.2	1342.6 ± 2577.2	3031.3 ± 4294.5	−65.57	<0.0001
Number of ED visits in 2010					
1	124,234 (70.54)	106,612 (72.88)	17,622 (59.04)	3223.7	<0.001
2–3 times	42,156 (23.94)	33,242 (22.73)	8914 (29.86)		
4–10 times	9173 (5.21)	6069 (4.15)	3104 (10.40)		
> 10 times	563 (0.32)	354 (0.24)	209 (0.70)		
Day of ED visit					
Weekday	111,941 (63.56)	92,024 (62.91)	19,917 (66.73)	155.78	<0.001
Weekend	64,185 (36.44)	54,253 (37.09)	9932 (33.27)		
OHCA					
No	175,468 (99.63)	145,977 (99.79)	29,491 (98.80)	658.45	<0.001
Yes	658 (0.37)	300 (0.21)	358 (1.20)		
Emergency treatment outcome					
Died prior to arrival	464 (0.26)	206 (0.14)	258 (0.86)	7977.9	<0.001
No subsequent visit	77,757 (44.15)	68,939 (47.13)	8818 (29.54)		
Hospitalization	20,975 (11.91)	13,306 (9.10)	7669 (25.69)		
Outpatient visit within 3 d	71,324 (40.50)	59,278 (40.52)	12,046 (40.36)		
Revisit within 3 d	5606 (3.18)	4548 (3.11)	1058 (3.54)		

Outcome is defined as treatment-seeking behavior displayed within 3 days of ED visit, with focus on the first subsequent action. If the patient was diagnosed with OHCA but there was still a record of subsequent treatment, priority was given to the action of treatment.
"Weekend" is defined as the patient visited the ED on Saturday or Sunday.
ED = emergency department; OHCA = out-of-hospital cardiac arrest; SD = standard deviation.

Table 4
Common disease diagnoses in the emergency department (ED) [2010 research, ≤64 years old vs. ≥65 years old (elderly)].

Disease diagnosis	ICD-9-CM	All patients *n* (%)	≤64 y old *n* (%)	≥65 y old *n* (%)	χ^2	*p*
V code		382 (0.22)	350 (0.24)	32 (0.11)	10,078	<0.001
Endocrine, nutritional and metabolic diseases	240–279	2613 (1.48)	1597 (1.09)	1016 (3.40)		
Diseases of skin and subcutaneous tissue	680–709	5172 (2.94)	4564 (3.12)	608 (2.04)		
Congenital anomalies	740–759	89 (0.05)	77 (0.05)	12 (0.04)		
Diseases of ear and mastoid process	380–389	2570 (1.46)	1980 (1.35)	590 (1.98)		
Disease of blood and blood-forming organs	280–289	402 (0.23)	251 (0.17)	151 (0.51)		
Certain conditions originating in perinatal period	631–676 760–779	1219 (0.69)	1211 (0.83)	8 (0.03)		
Diseases of respiratory system	460–519	19,992 (11.35)	17,642 12.06)	2350 (7.87)		
Diseases of genitourinary system	580–629	7524 (4.27)	5900 (4.03)	1624 (5.44)		
Diseases of digestive system	520–579	19,454 (11.05)	16,817 (11.50)	2637 (8.83)		
Diseases of nervous system	320–359	958 (0.54)	772 (0.53)	186 (0.62)		
Diseases of musculoskeletal system and connective tissue	710–739	3933 (2.23)	2971 (2.03)	962 (3.22)		
Disorders of eye and adnexa	360–379	1486 (0.84)	1333 (0.91)	153 (0.51)		
Diseases of circulatory system	390–459	5919 (3.36)	2736 (1.87)	3183 (10.66)		
Infectious and parasitic diseases	001–139	4245 (2.41)	3791 (2.59)	454 (1.52)		
Injury and poisoning	800–999	52,054 (29.55)	45,707 (31.25)	6347 (21.26)		
Neoplasms	140–239	1591 (0.90)	855 (0.58)	736 (2.47)		
Mental disorders	290–319	1777 (1.01)	1520 (1.04)	257 (0.86)		
Symptoms, signs, and ill-defined conditions	780–799	44,746 (25.41)	36,203 (24.75)	8543 (28.62)		

ICD-9-CM = International Classification of Diseases, 9th revision, Clinical Modification.

were significantly higher (NT$3239.5). Moreover, the number of ED visits, number of OHCA cases, and rate of hospitalization were also significantly higher in the old elderly population.

In the analysis of ED diagnosis in our study cohort, the young elderly population and old elderly population are also significantly different (Table 6).

4. Discussion

With advances in healthcare, Taiwan's population has been aging rapidly in recent years. People who are 65 years or older now account for more than 10% of the total population, whereas the percentage of those older than 85 years has increased from 0.24% to 0.86%. Because of altered physical functions, the elderly have more frequent use of emergency medical resources than younger patients. In our previous study, which was based on a regional hospital in Hsinchu in 2009, we found that diagnosis and disease status were frequently nonspecific with a higher triage Level 2 in elderly people seeking emergency services. This shows that medical conditions in ED elderly patients are more complex, making specific diagnosis difficult to establish in the ED period. In the present study, we found that the elderly patients (≥65 years old) accounted for 16.95% of all ED patients in 2010. This is slightly lower than that in the study of Yeh et al,[2] where elderly patients (≥65 years old) accounted for 18.96% of the total number of ED patients in a regional teaching hospital in 2003. This is also inconsistent with

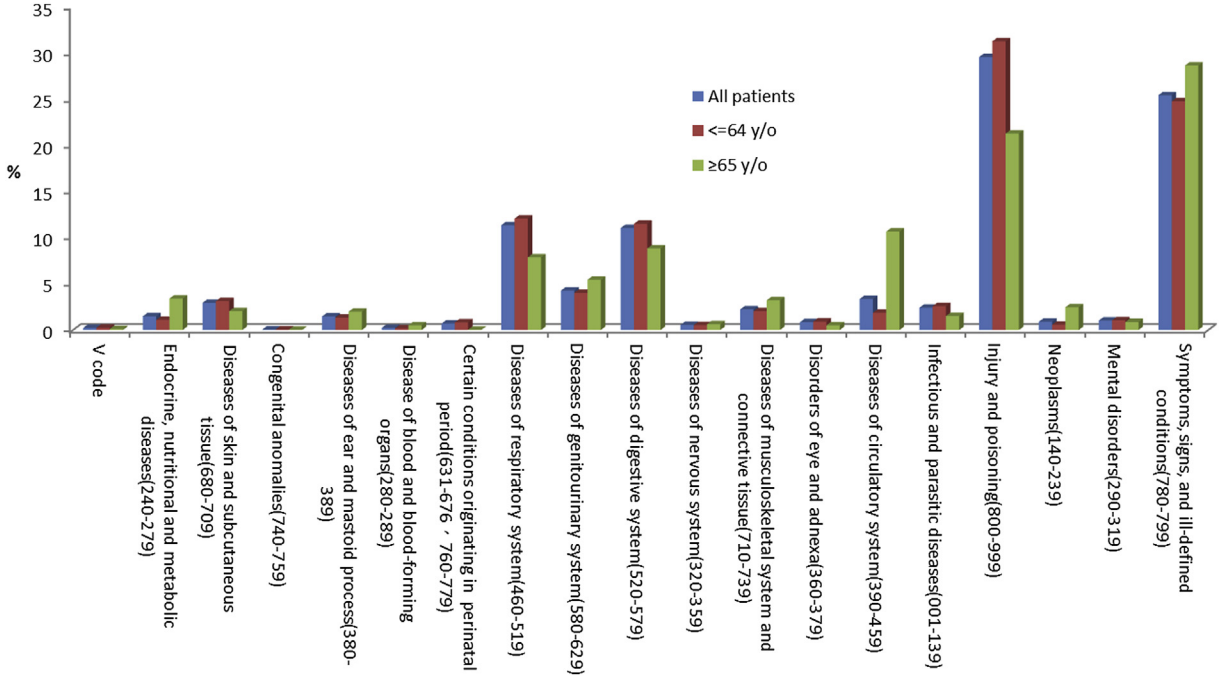

Figure 2. Common disease diagnoses in the emergency department (ED) [2010 research, ≤64 years old vs. ≥65 years old (elderly)].

Table 5
Elderly patient characteristics after classification (2010 research, 65–74 years old vs. ≥75 years old).

Variables	All patients *n* (%)	65–74 y old *n* (%)	≥75 y old *n* (%)	χ^2/t	*p*
Sex					
Female	14,430 (50.16)	6207 (51.94)	8223 (48.90)	25.90	<0.001
Male	14,337 (49.84)	5743 (48.06)	8594 (51.10)		
Mean age, mean ± SD (age)	76.9 ± 7.2	70.0 ± 2.6	81.9 ± 5.1	−9.13	<0.0001
Type of visited hospital					
Medical center	8133 (28.27)	3264 (27.31)	4869 (28.95)	15.85	0.0012
Regional hospital	14,171 (49.26)	5966 (49.92)	8205 (48.79)		
District hospital	6269 (21.79)	2621 (21.93)	3648 (21.69)		
Other	194 (0.67)	99 (0.83)	95 (0.56)		
ED costs, mean ± SD (NT$)	3048.0 ± 4267.8	2778.5 ± 4120.7	3239.5 ± 4359.3	−9.13	<0.0001
Number of ED visits in 2010					
1	16,874 (58.66)	7665 (64.14)	9209 (54.76)	291.85	<0.001
2–3 times	8661 (30.11)	3264 (27.31)	5397 (32.09)		
4–10 times	3030 (10.53)	947 (7.92)	2083 (12.39)		
>10 times	202 (0.70)	74 (0.62)	128 (0.76)		
Day of ED visit					
Weekday	19,183 (66.68)	7927 (66.33)	11,256 (66.93)	1.12	0.2893
Weekend	9584 (33.32)	4023 (33.67)	5561 (33.07)		
OHCA					
No	28,415 (98.78)	11,851 (99.17)	16,564 (98.50)	26.41	<0.001
Yes	352 (1.22)	99 (0.83)	253 (1.50)		
Emergency treatment outcome					
Died prior to arrival	254 (0.88)	71 (0.59)	183 (1.09)	253.93	<0.001
No subsequent visit	8470 (29.44)	3704 (31.00)	4766 (28.34)		
Hospitalization	7467 (25.96)	2563 (21.45)	4904 (29.16)		
Outpatient visit within 3 d	11,547 (40.14)	5197 (43.49)	6350 (37.76)		
Revisit within 3 d	1029 (3.58)	415 (3.47)	614 (3.65)		

Outcome is defined as treatment-seeking behavior displayed within 3 days of ED visit, with focus on the first subsequent action. If the patient was diagnosed with OHCA but there was still a record of subsequent treatment, priority was given to the action of treatment.
"Weekend" is defined as the patient visited the ED on Saturday or Sunday.
ED = emergency department; OHCA = out-of-hospital cardiac arrest; SD = standard deviation.

our previous study in a Hsinchu regional hospital in 2009, which showed that 12.6% of ED patients were elderly. Differences between regions and urbanization may account for these different demographic figures. According to national statistics data in 2005, elderly ED patients accounted for approximately 12–24% of the total number of ED patients.[8] In addition, previous reports had shown that EMS utilization is higher in elderly ED patients than in younger patients.[9–12]

In the current study, we found that the top ranking ICD-9 code in the elderly was "Symptoms, signs, and ill-defined conditions", followed by "Injury and poisoning". According to the health statistics of 2011 from the Taiwan Department of Health-Executive Yuan (Ministry of Health and Welfare), the percentages of the types of disease among ED cases were 26.2% for "Symptoms, signs, and ill-defined conditions", 24.3% for "Injury and poisoning", 14.3% for "Diseases of the respiratory system", and 10.5% for "Diseases of the

Table 6
Elderly patient common disease diagnoses in the ED (2010 research, 65–74 years old vs. ≥75 years old).

Disease diagnosis	ICD-9	All patients *n* (%)	65–74 y old *n* (%)	≥75 y old *n* (%)	χ^2	*p*
V code		31 (0.11)	9 (0.08)	22 (0.13)	233.72	<0.001
Endocrine, nutritional and metabolic diseases	240–279	989 (3.44)	368 (3.08)	621 (3.69)		
Diseases of skin and subcutaneous tissue	680–709	573 (1.99)	281 (2.35)	292 (1.74)		
Congenital anomalies	740–759	12 (0.04)	3 (0.03)	9 (0.05)		
Diseases of ear and mastoid process	380–389	565 (1.96)	281 (2.35)	284 (1.69)		
Disease of blood and blood-forming organs	280–289	145 (0.50)	55 (0.46)	90 (0.54)		
Certain conditions originating in perinatal period	631–676 760–779	7 (0.02)	3 (0.03)	4 (0.02)		
Diseases of respiratory system	460–519	2280 (7.93)	739 (6.18)	1541 (9.16)		
Diseases of genitourinary system	580–629	1570 (5.46)	628 (5.26)	942 (5.60)		
Diseases of digestive system	520–579	2524 (8.77)	1049 (8.78)	1475 (8.77)		
Diseases of nervous system	320–359	181 (0.63)	73 (0.61)	108 (0.64)		
Diseases of musculoskeletal system and connective tissue	710–739	928 (3.23)	397 (3.32)	531 (3.16)		
Disorders of eye and adnexa	360–379	147 (0.51)	84 (0.70)	63 (0.37)		
Diseases of circulatory system	390–459	3079 (10.70)	1164 (9.74)	1915 (11.39)		
Infectious and parasitic diseases	001–139	439 (1.53)	154 (1.29)	285 (1.69)		
Injury and poisoning	800–999	6081 (21.14)	2839 (23.76)	3242 (19.28)		
Neoplasms	140–239	716 (2.49)	326 (2.73)	390 (2.32)		
Mental disorders	290–319	245 (0.85)	93 (0.78)	152 (0.90)		
Symptoms, signs, and ill-defined conditions	780–799	8255 (28.70)	3404 (28.49)	4851 (28.85)		

ED = emergency department; ICD-9 = International Classification of Diseases, 9th revision.

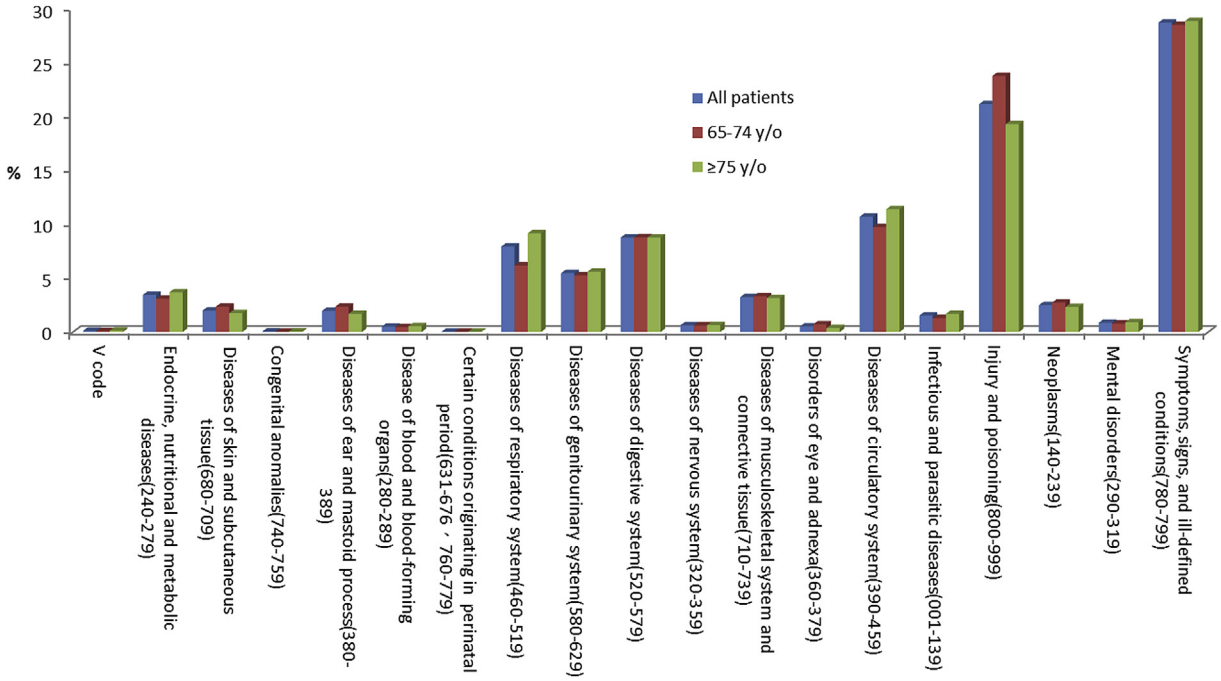

Figure 3. Elderly patient common disease diagnoses in the emergency department (ED) (2010 research, 65–74 years old vs. ≥75 years old).

digestive system" (Figure 3).[3] In Yeh et al's study,[2] the most common diagnosis was "Symptoms, signs, and ill-defined conditions", followed by "Diseases of the digestive system", "Diseases of the respiratory system", and "Injury and poisoning". The main ED diagnoses in a study by Cao (2004)[13] included "Injury and poisoning" (23.11%), "Symptoms, signs, and ill-defined conditions" (18.07%), "Diseases of the digestive system" (16.6%), and "Diseases of the respiratory system" (15.21%). Our study was consistent with the above-mentioned studies in terms of ED diagnosis of elderly patients. ED elderly patients often present with vague complaints or nonspecific illness, making a definitive diagnosis difficult to make during short-term ED assessment.[14]

Overall, the elderly often have complex medical and physical conditions that frequently require utilization of ED services. In an aging society, geriatrics is a subject that is no longer easily ignored, and emergency medical care for the elderly in particular is a cause for concern in emergency and critical care medicine. Although analysis of the data from the National Health Insurance Database was a complicated process, it was still possible to find differences in the mode of seeking treatment for each year. It was even possible to find periodic differences in ED visit characteristics for each season of a specific year. Because these results were based on a national database, they have an important reference value.

4.1. Limitations of the study

This study is a retrospective understanding of the diagnosis and demographic details of elderly ED patients via an analysis of nationwide health data. Bias may exist in our study when errors or misses occurred in the process of coding for the issues of medical reimbursement. However, this was considered minor in our study because the main purpose and the methodology of the study were only aimed at looking into the simple demographics of elderly ED patients by including the crude ED diagnosis. Furthermore, this coding behavior is not related to reimbursement in our country.

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